

# **Water Data to Answer Urgent Water Policy Questions: Shale Gas Development in the Susquehanna River Basin**

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# Water Data to Answer Urgent Water Policy Questions

## Shale Gas Development in the Susquehanna River Basin

Find the report at:

[www.nemw.org](http://www.nemw.org)

**Water Data to Answer Urgent Water Policy Questions:**

Monitoring design, available data, and filling data gaps for determining whether shale gas development activities contaminate surface water or groundwater in the Susquehanna River Basin



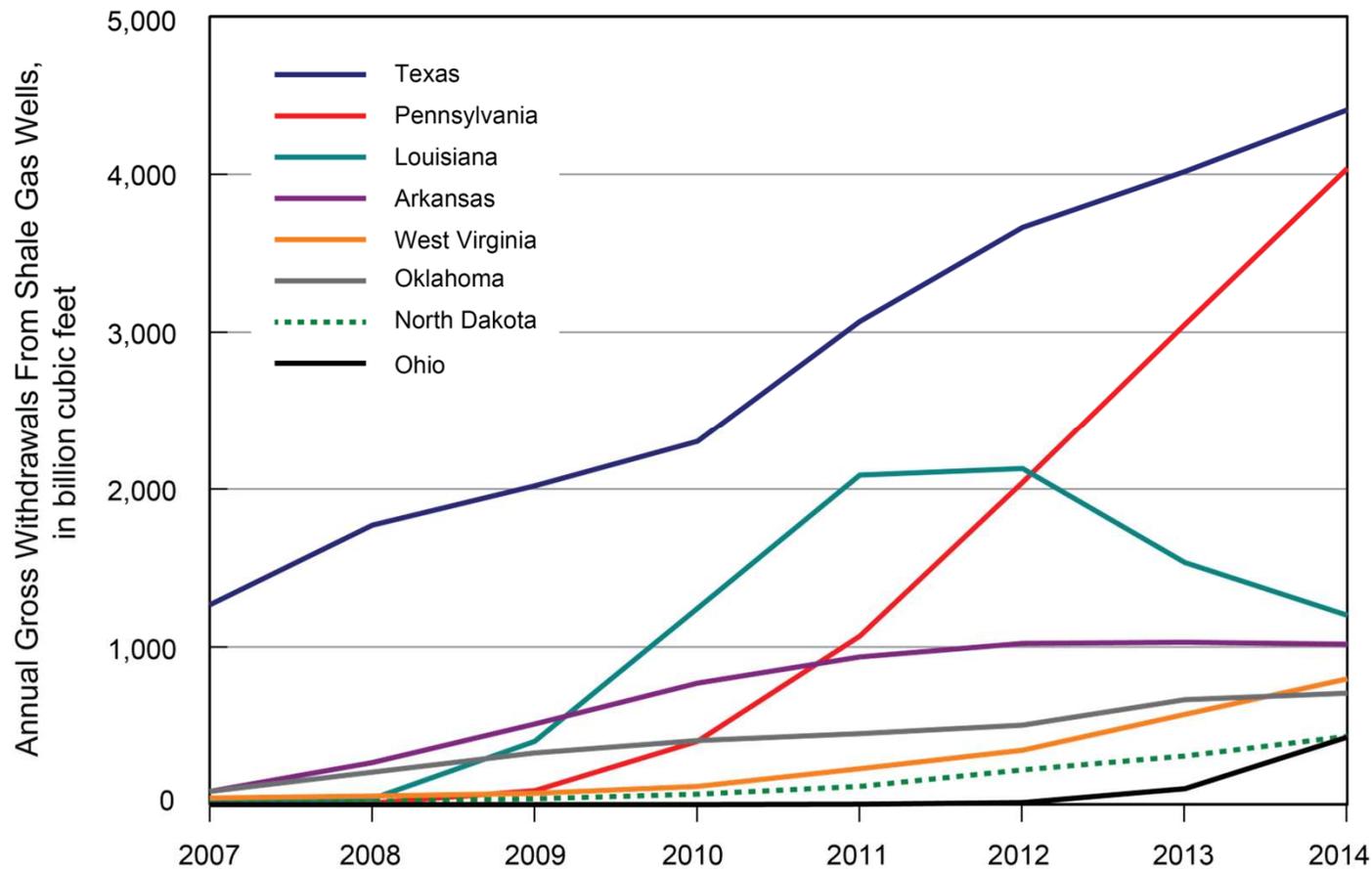
*The second in a series of three reports focused on water data needed to address water policy issues. The first report focuses on agricultural management practices in the Lake Erie drainage basin, and the next report will provide an overview of existing water-quality data across the Northeast-Midwest region.*

A report published by  
The Northeast-Midwest Institute in collaboration with the U.S. Geological Survey





# Annual gross withdrawals of natural gas from shale gas wells for the top 8 states that produce shale gas



(data from U.S. Energy Information Administration, 2015)



Study design to answer  
“Do shale gas development activities  
contaminate surface water or  
groundwater?”

**Water-Quality Data:**

Water-quality (and streamflow) data  
to detect change over time

**Appropriate Monitoring Sites:**

Monitoring sites in areas with  
high volume hydraulic fracturing  
(HVHF) wells

**Ancillary Data:**

Shale gas activity, geology, land-use,  
and climate data to correlate water-  
quality change with changes on the  
land

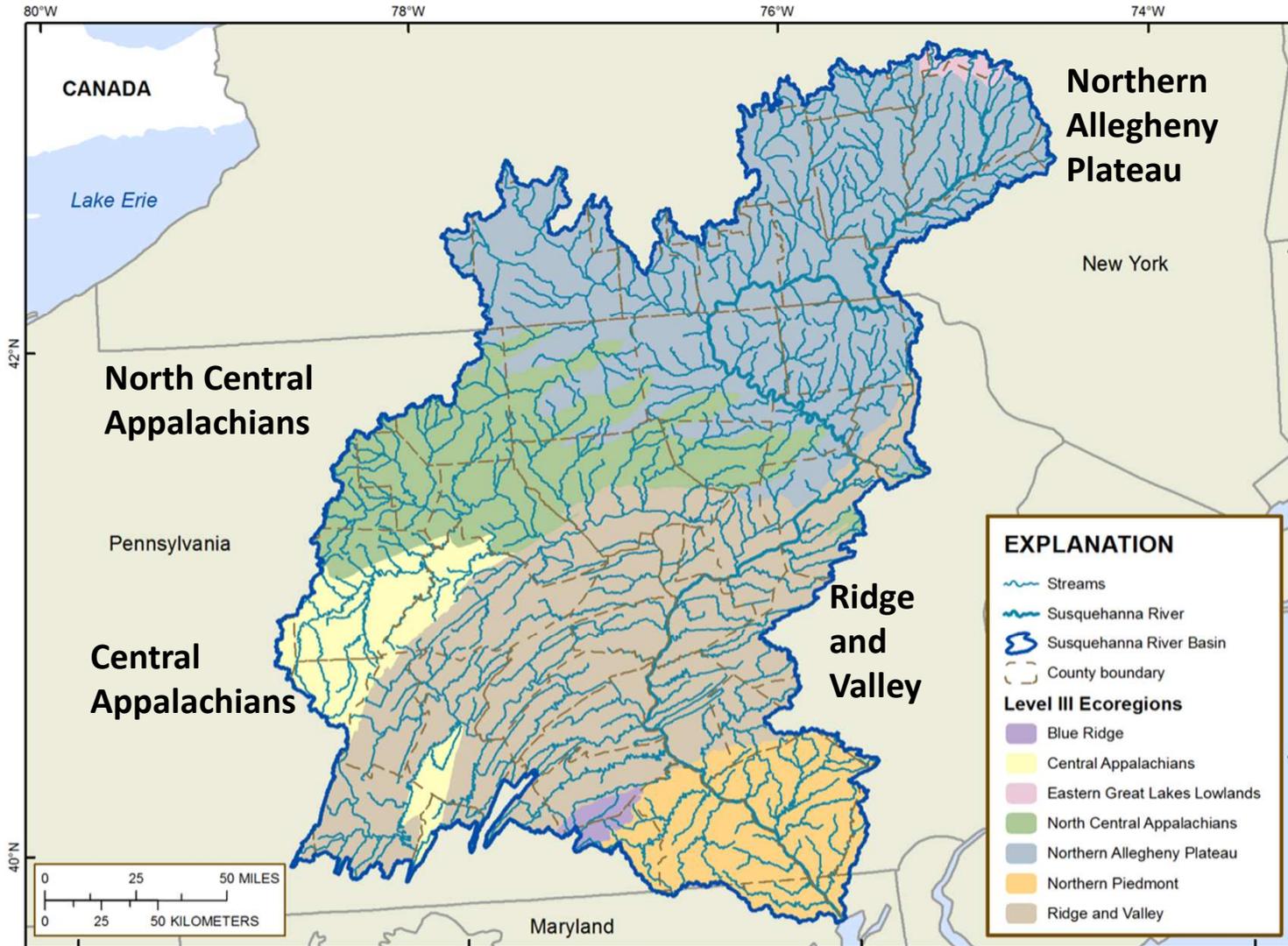


Water data needed to answer “Do shale gas development activities contaminate surface water?”

- Monitoring sites in each ecoregion:
  - Small watersheds
  - High density HVHF permits ( $>0.5$  HVHF permits/mi<sup>2</sup>)
  - Reference sites
- 26 chemical and field parameters plus streamgage
- Monthly sampling preferred

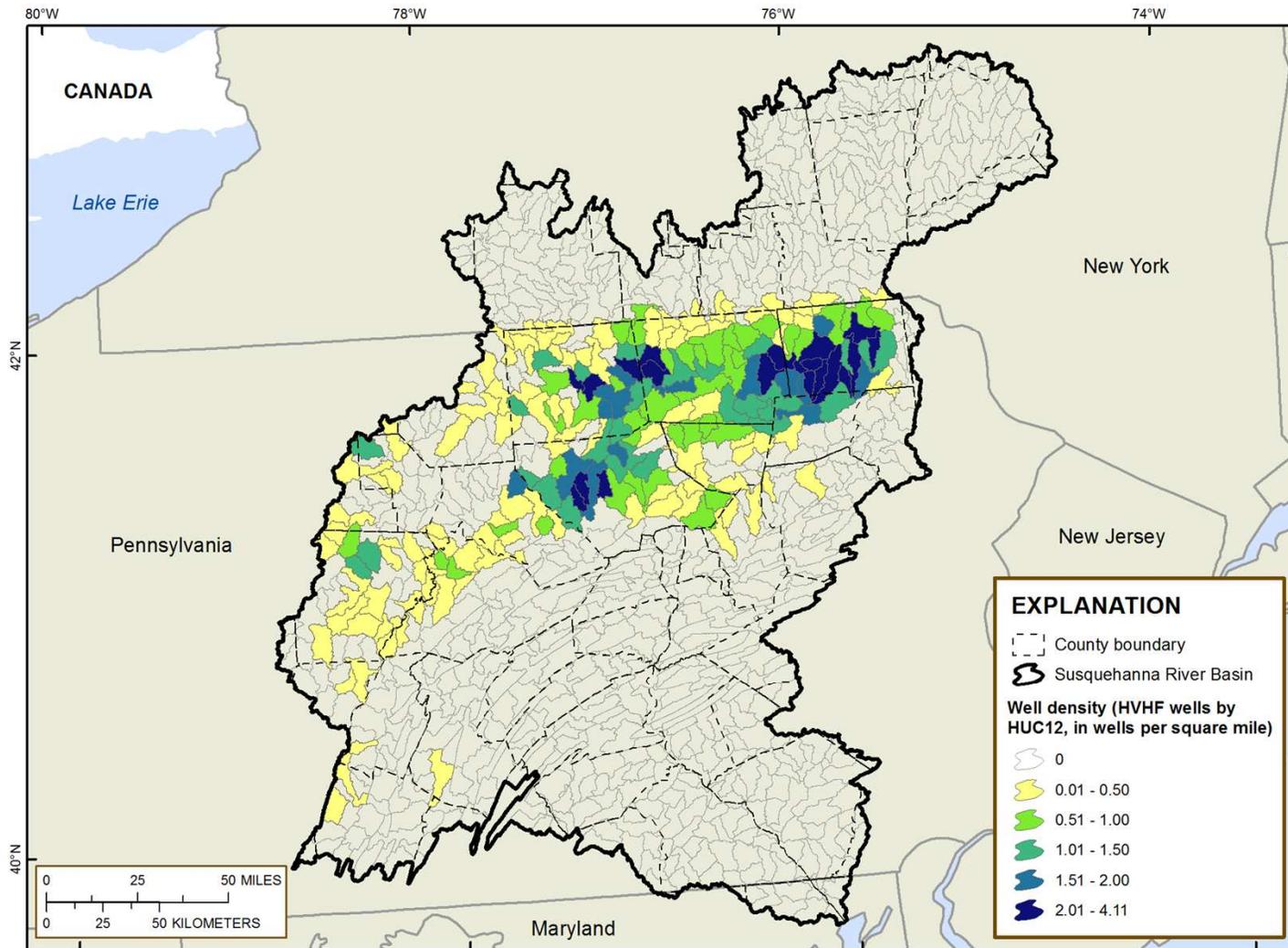


# Ecoregions in the Susquehanna River Basin





# Density of permitted HVHF wells in the Marcellus and Utica Shale

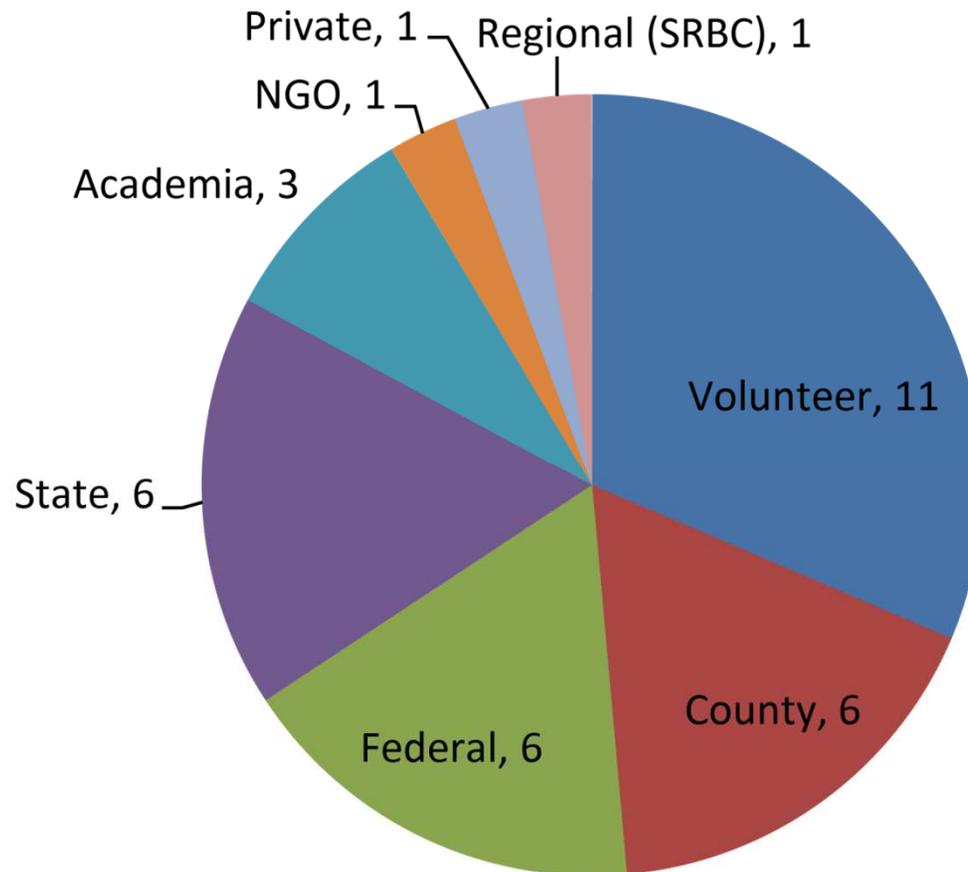


State and county lines from U.S. Geological Survey, 2005, 1:2,000,000-scale digital data  
Albers projection, NAD 1983

HUC12 watersheds November 2012 release accessed May 1, 2013 at <http://ftp.fhv.nrcs.usda.gov/wbd/>  
Well density based on wells from Pennsylvania Department of Environmental Protection (2015a)

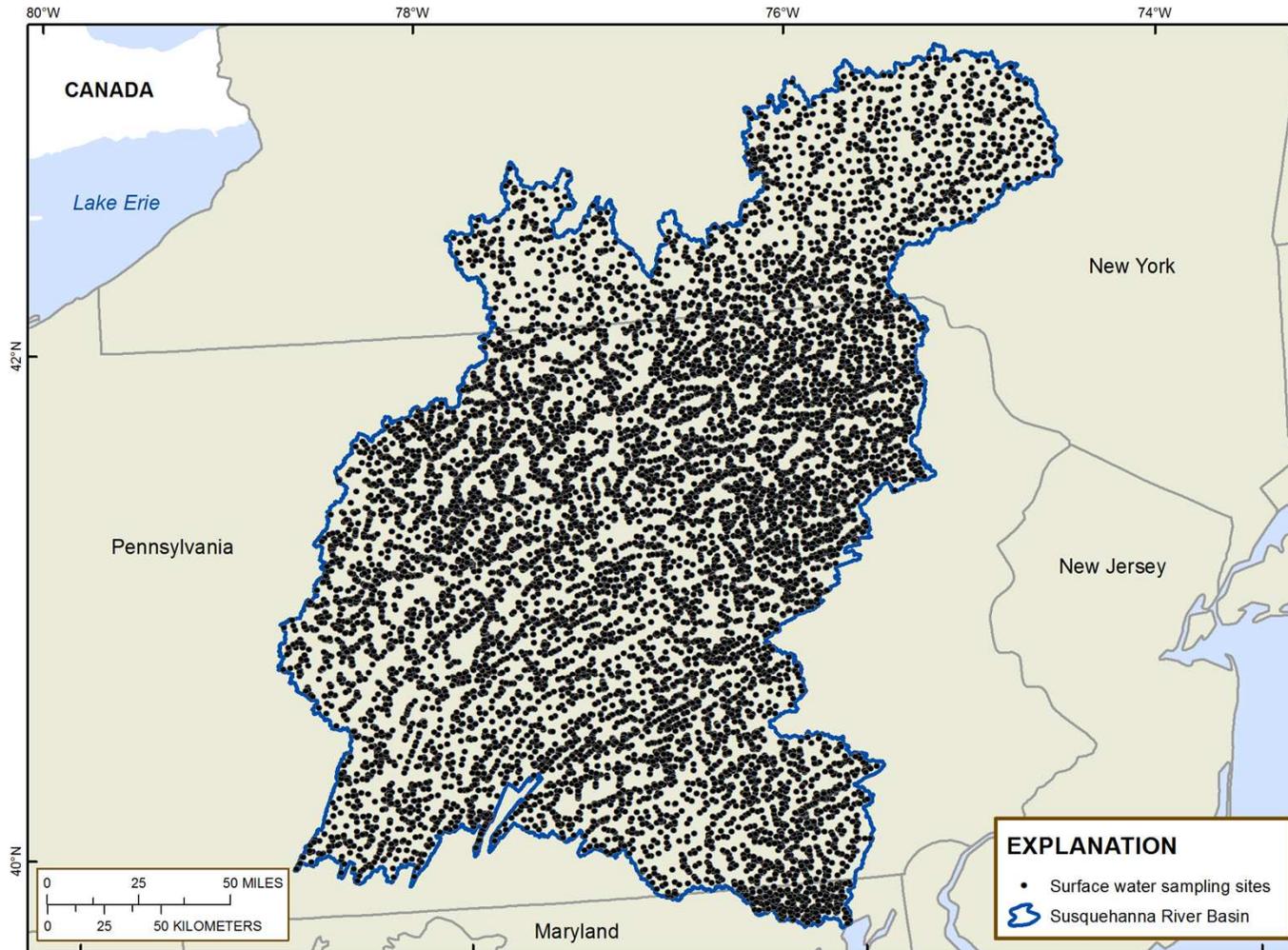


# Surface water monitoring organizations (n=35)





# Surface water monitoring sites for comprehensive suite of parameters (n=14,730)



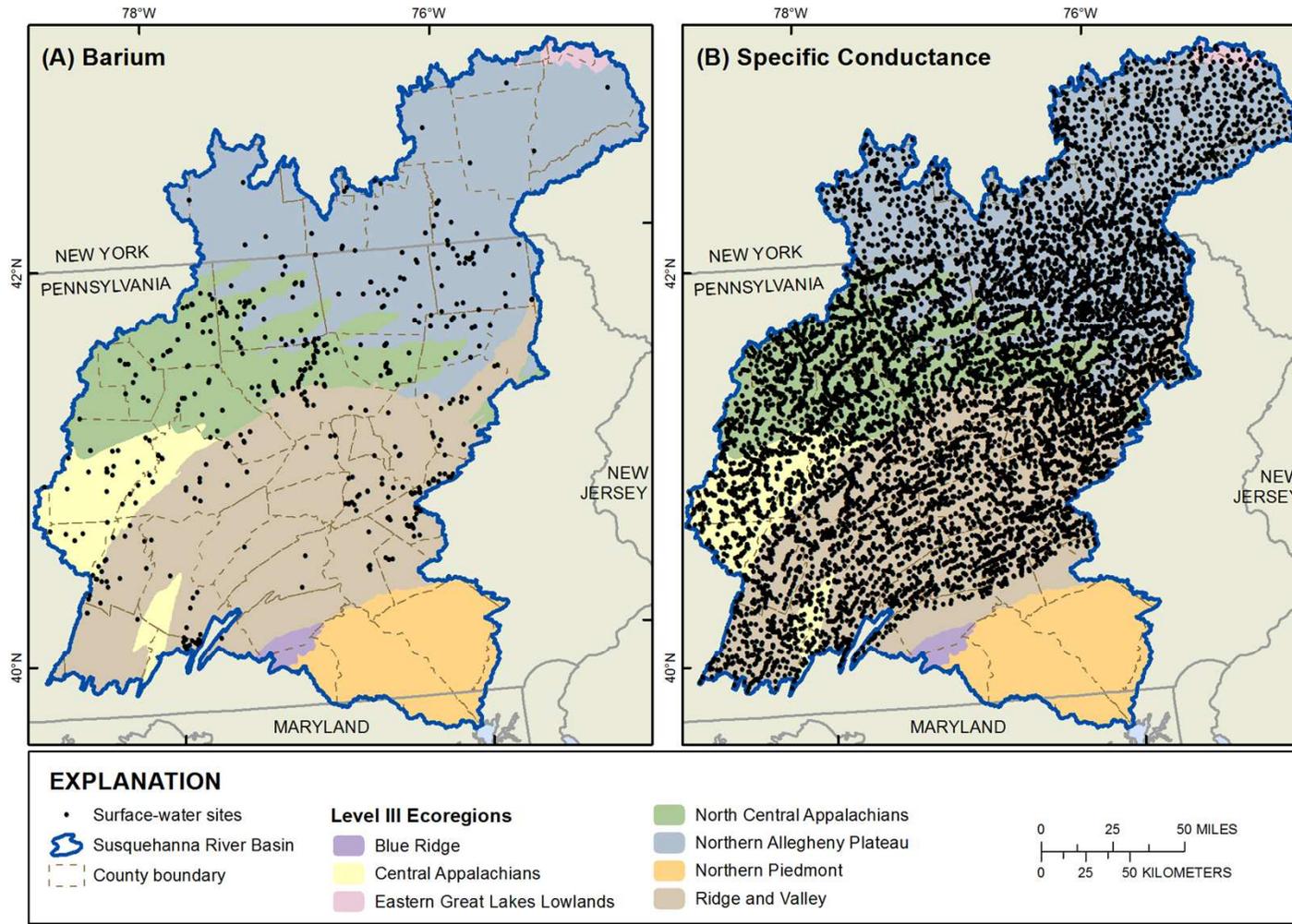
State and county lines from U.S. Geological Survey, 2005, 1:2,000,000-scale digital data  
Albers projection, NAD 1983



# Monitoring sites with barium and specific conductance data in the Marcellus and Utica Shale area

n= 549 sites

n=11,890 sites

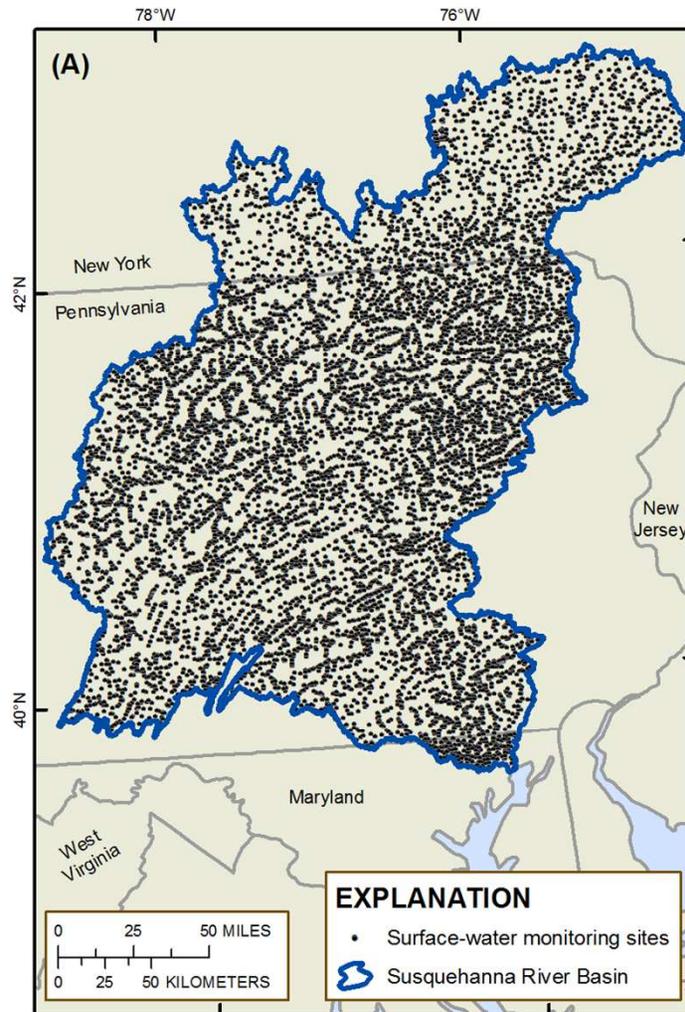


State and county lines from U.S. Geological Survey, 2005, 1:2,000,000-scale digital data  
Albers projection, NAD 1983

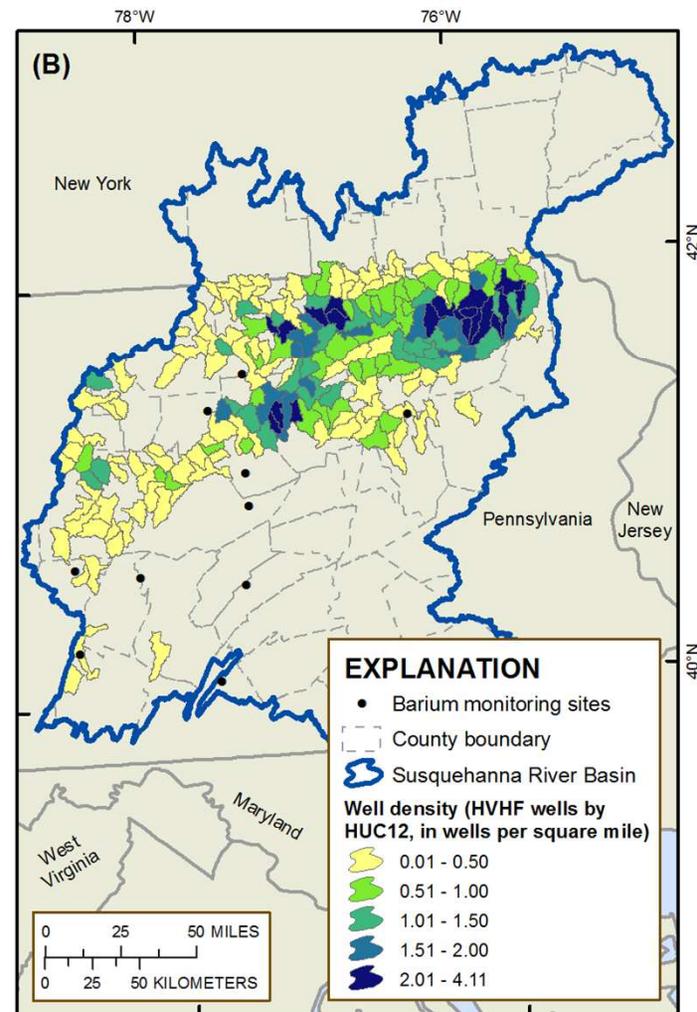
Ecoregions from U.S. Environmental Protection Agency (2010)

Surface water monitoring sites  
for comprehensive suite of  
parameters (n=14,730)

Sites with minimum data for  
detecting changes in barium  
concentration (n=10)



State and county lines from U.S. Geological Survey, 2005, 1:2,000,000-scale digital data  
Albers projection, NAD 1983



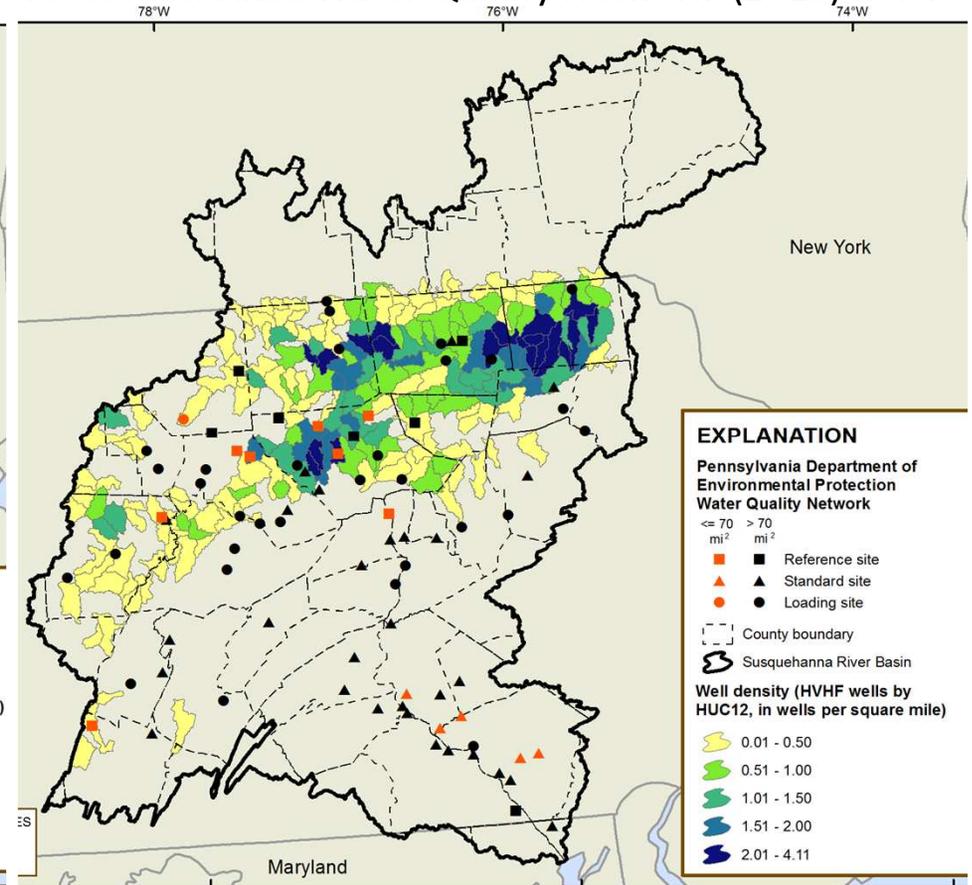
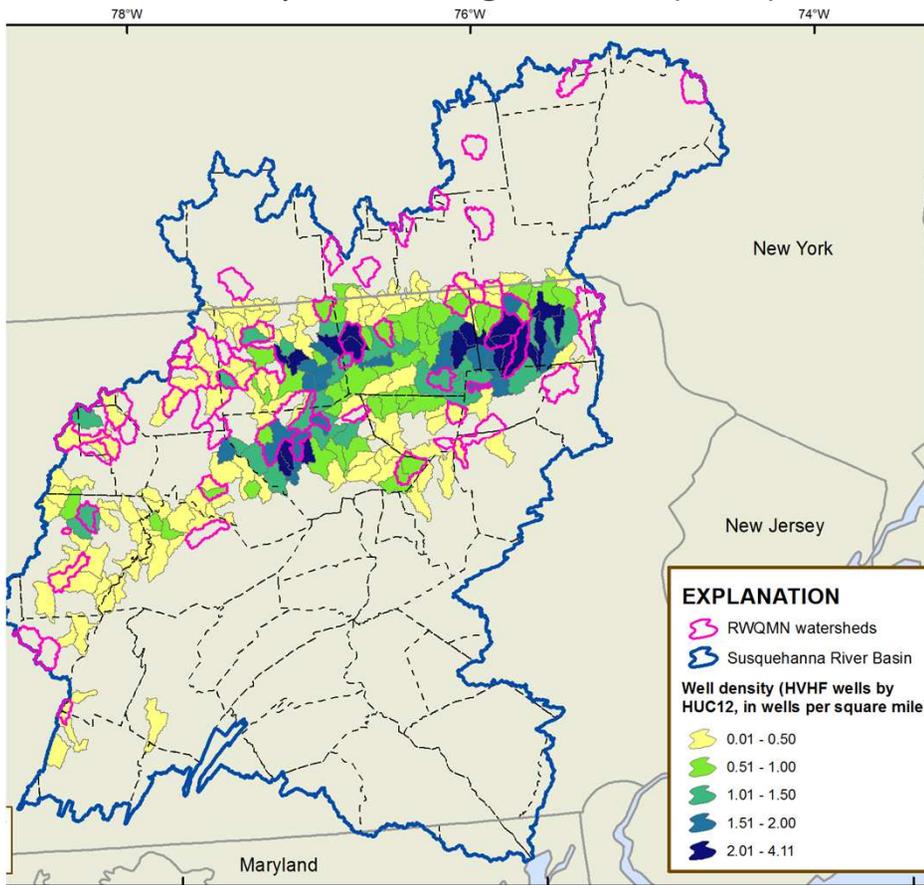
HUC12 watersheds November 2012 release accessed May 1, 2013 at <http://ftp.ftw.nrcs.usda.gov/wbd/>  
Well density based on wells from Pennsylvania Department of Environmental Protection (2015a)



# Recently initiated monitoring programs

Susquehanna River Basin Commission Remote Water Quality Monitoring Network (2015) n=58

Pennsylvania Department of Environmental Protection Fixed Water Quality Network (2015) n=74



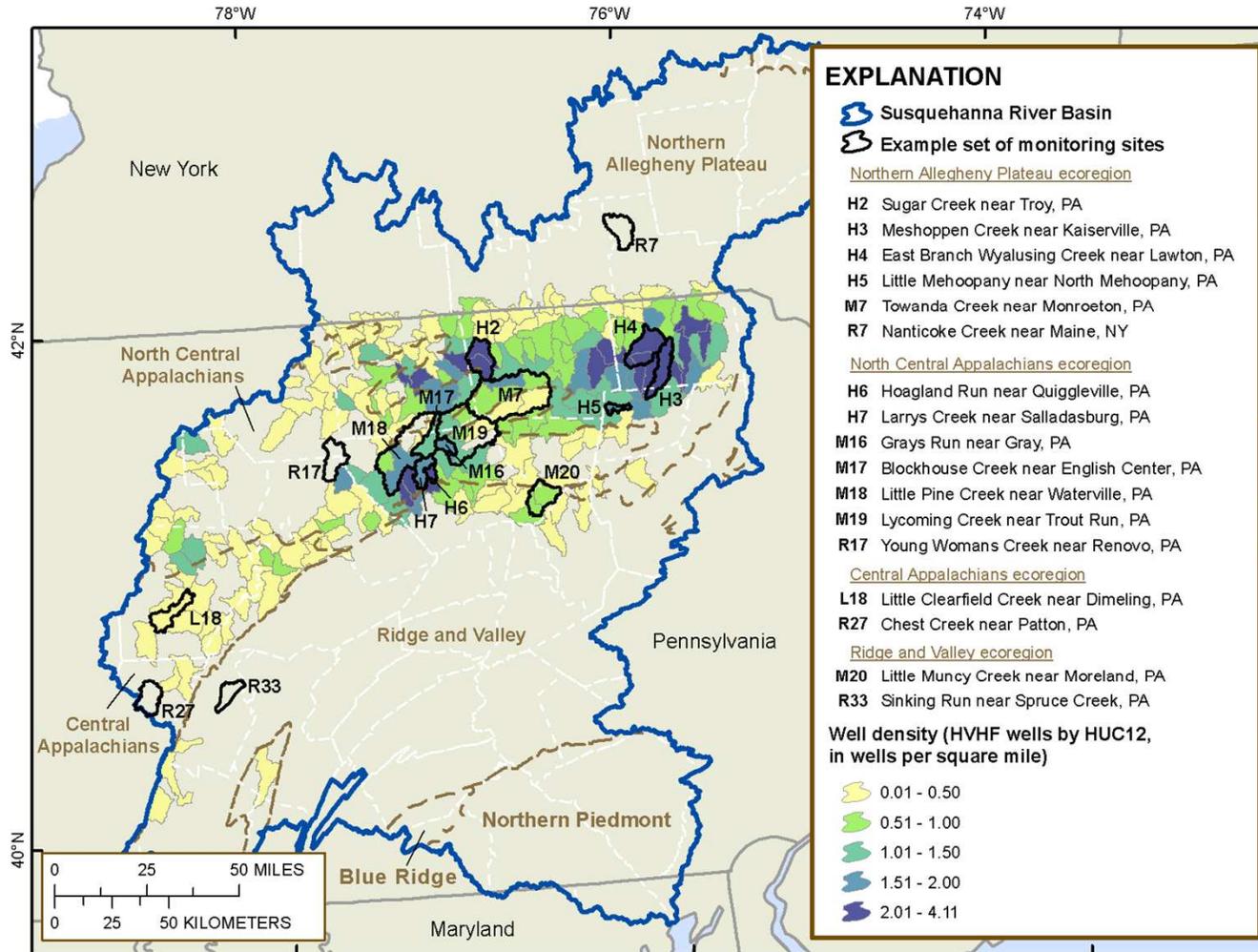


## Recommendations for filling surface water data gaps: Right data in the right places

- Increase monitoring at a minimum of 8 targeted surface water monitoring sites; additional monitoring sites are highly recommended
- Analyze for the suite of priority surface-water parameters and streamflow at each monitoring site
- Maintain long-term monitoring at selected sites



# Example set of surface water sites for increased targeted sampling

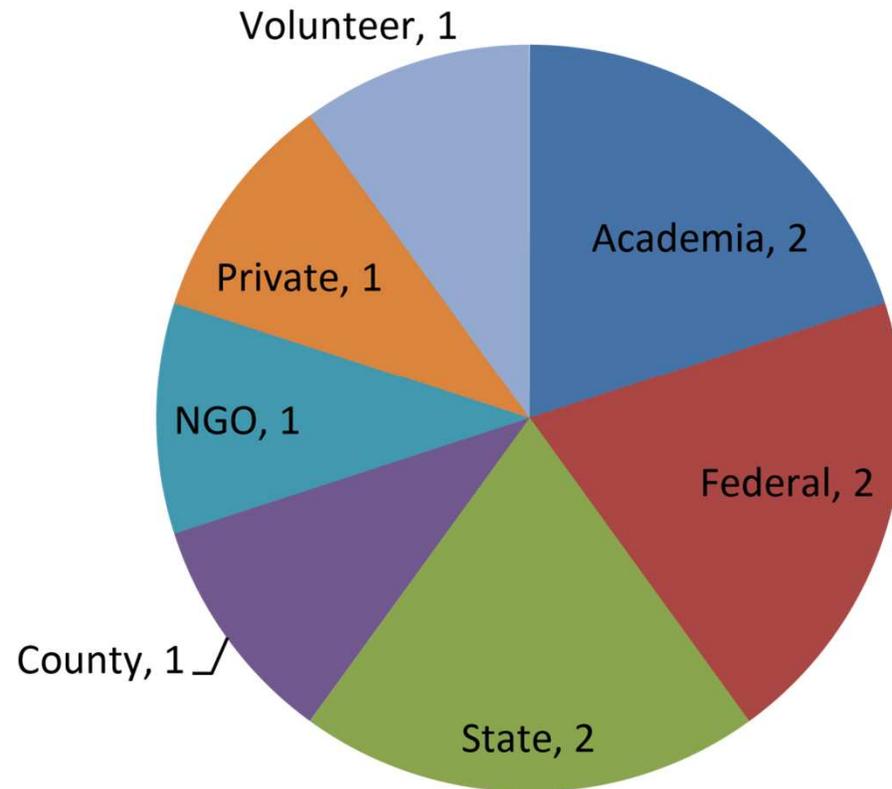


State and county lines from U.S. Geological Survey, 2005, 1:2,000,000-scale digital data  
Albers projection, NAD 1983

Well density based on wells from Pennsylvania Department of Environmental Protection (2015a)



# Groundwater monitoring organizations (n=10)



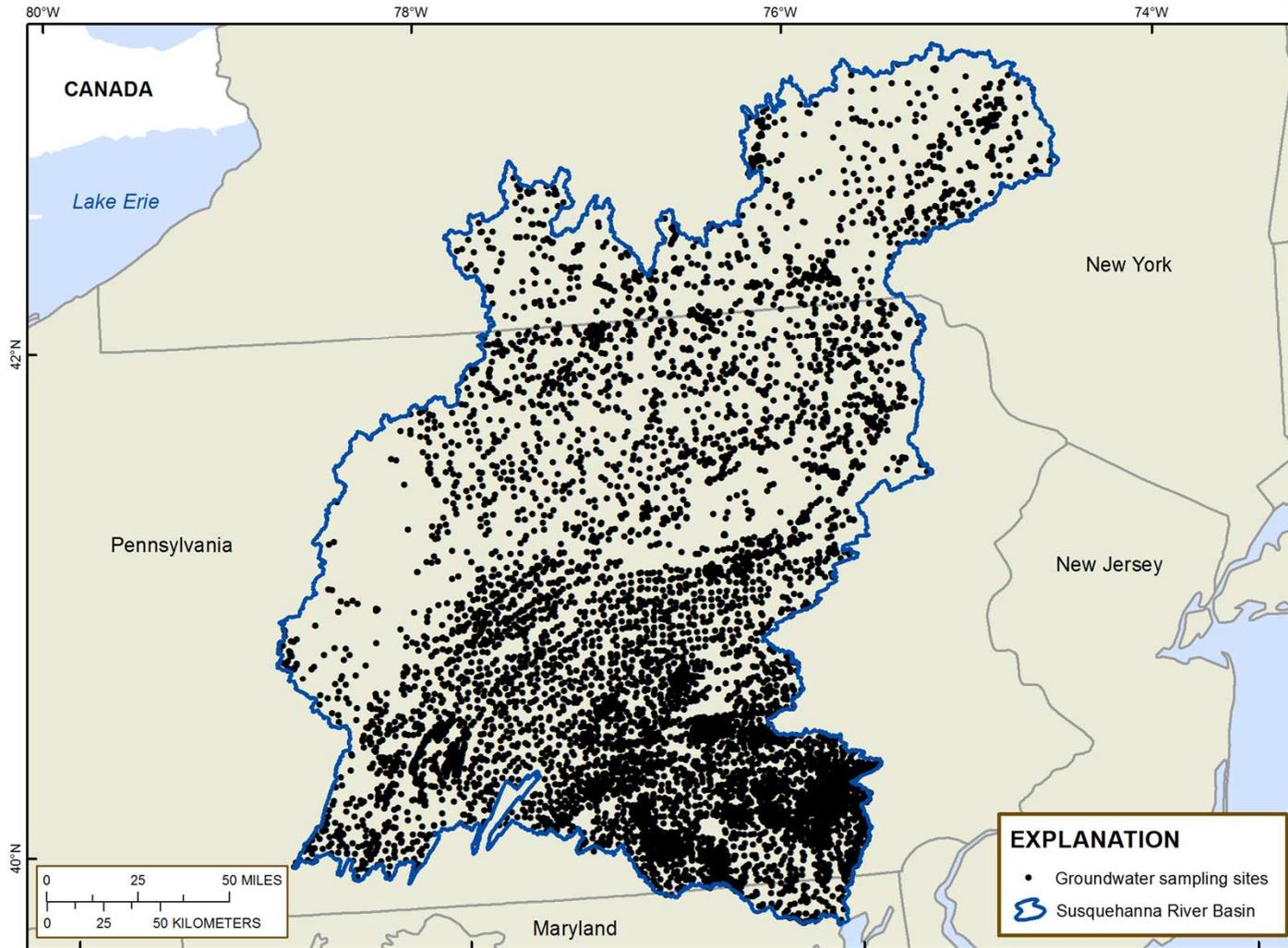


Water data needed to answer “Do shale gas development activities contaminate groundwater?”

- 27 chemical and field parameters
- Network monitoring design:
  - 5 monitoring networks needed
  - 25-30 sampling sites per network, each site within 1 mile of HVHF well
  - Two samples at each site, separated by approximately 10 years and taken before and after shale gas development



# Groundwater sampling sites for comprehensive suite of parameters (n=9,761)

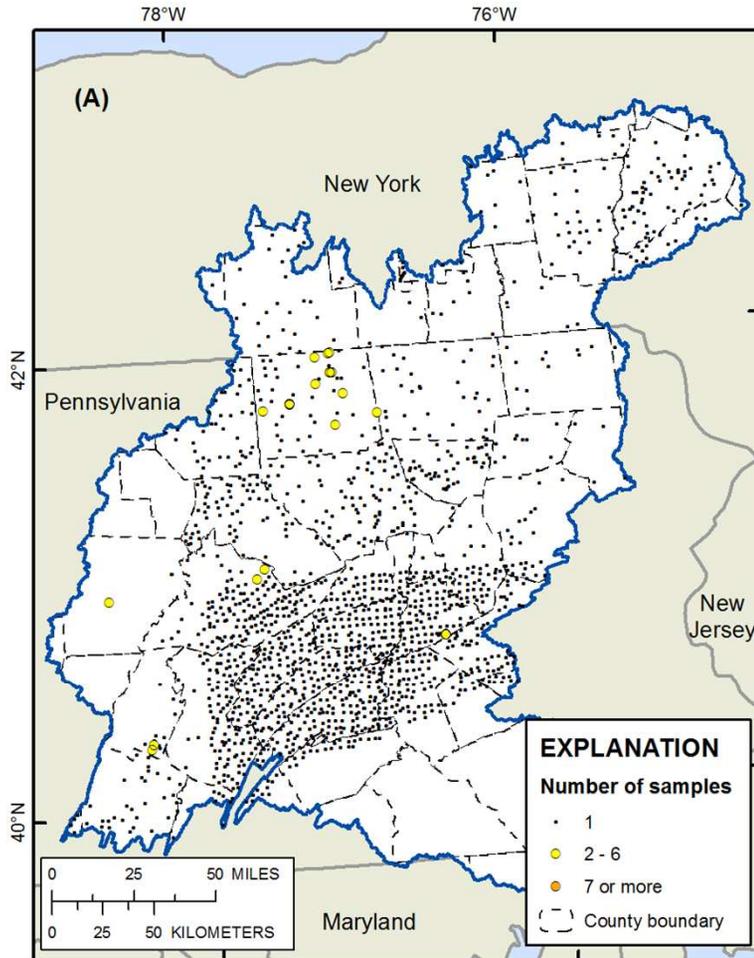


State and county lines from U.S. Geological Survey, 2005, 1:2,000,000-scale digital data  
Albers projection, NAD 1983



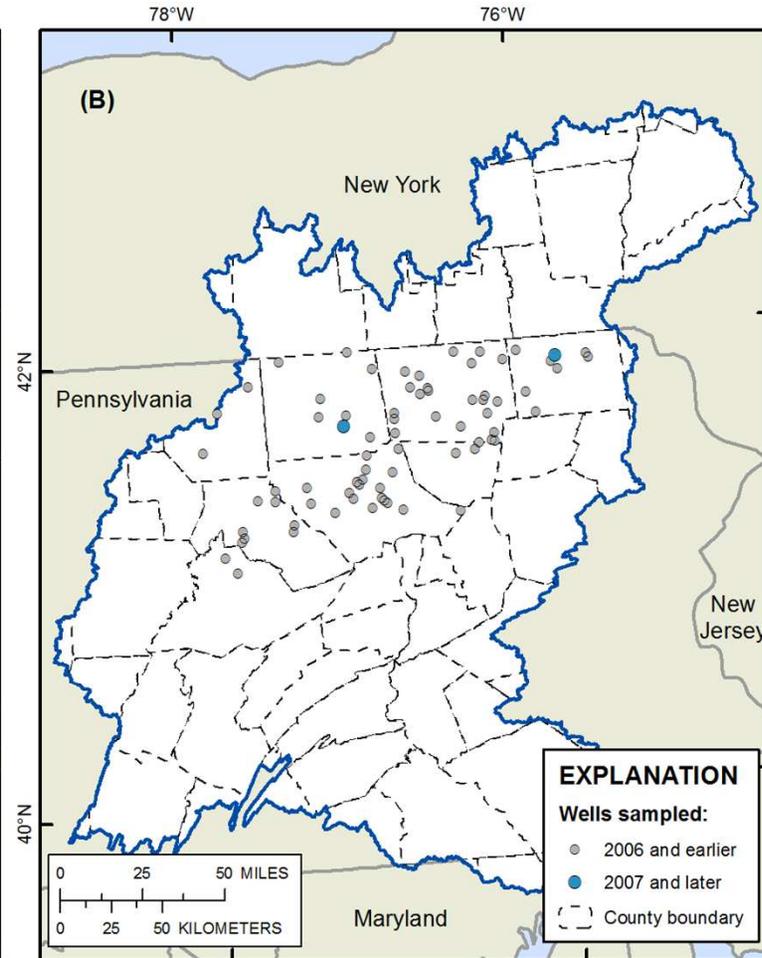
# Existing groundwater sampling sites for bromide

All sites (n= 1,686)



State and county lines from U.S. Geological Survey, 2005,  
1:2,000,000-scale digital data  
Albers projection, NAD 1983

Sites within 1 mile of an HVHF well (n=74)



State and county lines from U.S. Geological Survey, 2005,  
1:2,000,000-scale digital data  
Albers projection, NAD 1983

Wells from Pennsylvania Department  
of Environmental Protection (2015a)



# Recommendations for filling groundwater data gaps: Right data in the right places

- Design and implement a systematic, long-term groundwater monitoring program.
- Establish a coordinating entity with representation from water monitoring organizations, shale gas industry, domestic well owners, and public citizens.



# Policy Needs

- Incentives for shale gas industry to share water quality data and participate in water monitoring planning
- Coordinating entity to develop surface water and groundwater sampling plans
- Funding:
  - Increased surface water monitoring
  - Streamgages
  - Groundwater monitoring network



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